



Marion Creek Wetland Restoration Project Final Report

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Executive Summary

The Marion Creek Wetland Restoration Project aims to restore a series of interconnected wetland features, as well as associated upland habitat, and is occurring on the Nature Conservancy of Canada's Thunder Hill Ranch Conservation Area that is located in the Upper Columbia Valley approximately 5 km northwest of Canal Flats, BC. The project addresses the need to restore key reaches of Marion Creek that have been altered through past ditching, channeling, and draining activities aimed at controlling flow for downstream ranching operations. NCC aims to restore the natural hydrology of Marion Creek, create climate resiliency on the landscape, and improve habitat for wildlife including several species at risk such as Westslope Cutthroat Trout and Western Painted Turtle. This project aligns with the FWCP's "Columbia Region Wetlands & Riparian Areas Action Plan" and addresses Action 13: Restore and create wetland/riparian habitat-P1 and Action 36: Restoration of fish rearing and spawning habitat-P2. This project also aligns with the FWCP's "Columbia Region Uplands & Dryland Action Plan" and addresses Action 12: Restoration of upland habitats-P1. NCC has completed Phase 1a of the project, including extensive planning and designing of wetland and stream features, repairing a temporary diversion ditch, and stockpiling materials on site in preparation of the upcoming phases.

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Introduction

Background

The Marion Creek Wetland Restoration Project (“the Project”) aims to restore a series of interconnected wetland features and associated upland habitat on the Nature Conservancy of Canada’s (NCC) Thunder Hill Ranch Conservation Area. This property is located in the Upper Columbia Valley approximately 5 km northwest of Canal Flats, BC. The project addresses the need to restore key reaches of Marion Creek that have been altered through past ditching, channeling, and draining activities aimed at controlling flow for downstream ranching operations. NCC hopes to restore the natural hydrology of Marion Creek and create climate resiliency on the landscape to benefit local populations of Westslope Cutthroat Trout (WCT; *Oncorhynchus clarki lewisi*) and a diversity of other wildlife species. The project will take specific action to restore habitat for waterfowl, shorebirds, bats, and at least 10 species at risk including American Badger (*Taxidea taxus*), Western Painted Turtle (*Chrysemys picta* pop.2), Common Nighthawk (*Chordeiles minor*), and Western Toad (*Anaxyrus boreas*) (NCC 2021). Constructing a complex of wetlands connected by a restored stream channel associated with Marion Creek will restore natural hydrology and significantly improve critical habitat for wildlife and key ungulate winter range, rangeland, recharge groundwater, address the urgent need to improve resiliency of local wetland ecosystems that are under threat of the impacts of climate change by buffering the seasonal availability of water resources, improving water quality for aquatic species, and by ensuring critical habitat for wetland-dependent species (NCC 2021).

The project aims to return a section of the stream to its historic channel, connected by a series of tiered wetland pools mimicking the beaver-created ponds that were historically present on the landscape. The wetlands will slow the flow of water, reducing erosion, providing filtration, and retaining water for slower release into the late summer and fall. Marion Creek also supports a genetically distinct population of WCT, making them important for the conservation of the species. Since the initial funding application to FWCP, this project has expanded to include a stronger focus on improving WCT habitat through improved temperature refuge and habitat diversification.

Statement of Need

The need for restoration stems from past alterations that were made to Marion Creek to accommodate downstream livestock production operations. Since the mid-1960’s, virtually all the wetlands and streams within the watershed have been altered by ditching, channeling, and draining to provide water for irrigating hay fields on the shores of Columbia Lake (Biebighauser 2018; as cited by NCC 2021). Several issues resulted from these past alterations. Ditches dug to divert streams and runoff lowered groundwater tables, providing conditions for shrubs and willows to dominate in place of sedges, grasses, and aquatic plants. The ditches also concentrated runoff into narrow channels, eliminating water from natural wetlands and reducing soil moisture content in nearby upland areas. Marion Creek has become channelized and disconnected from its floodplain and experiences extreme soil erosion which impacts downstream aquatic invertebrates and reduces habitat quality for fish such as WCT (Biebighauser 2018; as cited by NCC 2021).

Goals and Objectives and Linkage of FWCP Action Plans and specific Actions

The primary goal at the Project outset was to complete Phase 1 of the Marion Creek Watershed Ecosystem Restoration Plan (Biebighauser 2018) by constructing several wetland features within the floodplain of Marion Creek to restore natural flow dynamics on the landscape and improve habitat for wildlife and species at risk. From NCC's FWCP funding application (NCC 2021) the original goals and objectives of the project are as follows:

Objective 1: Based on the Marion Creek Watershed Ecosystem Restoration plan developed for Thunder Hill Ranch, improve landscape-scale climate resilience by constructing new wetlands in the floodplain of Marion Creek in a location that once contained natural wetlands that have since been drained and filled.

- A wetland restoration specialist will be hired to implement the restoration plan, ensure appropriate permits are obtained, and provide technical assistance and quality control oversight during construction.
- A local contractor with skilled heavy equipment operators will be selected to implement wetland construction activities. Up to 6 wetland features will be constructed resulting in 4 ha of new wetlands and 6 ha of enhanced upland habitat.
- Constructed wetlands will be connected to Marion Creek to provide additional habitat for native fish species, and will be built with varying sizes, depths, and shapes. Wetlands will retain water on the landscape through careful placement of clay soils, and features such as ridges, peninsulas, and islands will be incorporated into the design to improve diversity of wildlife habitat. Large woody debris will be placed on site, compacted soils will be loosened, and a diversity of native trees, shrubs, wildflowers, and grasses will be sown and planted throughout the restored site.
- Irrigation needs of the downstream Columbia Lake Ranch will be preserved as the wetlands will hold water on the landscape and provide a steady flow for downstream requirements throughout the year.
- Success will be measured based on the number of wetlands constructed and the size (in ha) of wetland and upland habitat improved through restoration activities.

Objective 2: Improve habitat for wildlife and species at risk by decompacting soil, enhancing riparian buffer around constructed wetlands, and encouraging growth of native plants.

- Soil derived from the wetland excavation will be spread over adjacent upland areas and existing upland soils will be decompacted using the "rough and loosen" technique. This will improve habitat for burrowing wildlife such as Columbian Ground Squirrel (*Urocitellus columbianus*) and American Badger and will provide topographical variation to encourage the growth of diverse plant assemblages.
- Improved hydrologic function resulting from reconnecting wetlands to Marion Creek will also flood areas that are currently dominated by invasive plants [e.g., Reed Canarygrass (*Phalaris arundinacea*)], helping to reduce the occurrence of these plants and promote the establishment of native emergent and aquatic vegetation that is important for waterfowl and shorebirds.
- Desirable native plants such as sedges and bulrushes growing within the work area will be salvaged and replanted where possible, and a diversity of native trees, shrubs, wildflowers, and grasses will be sown and planted within the project area.

- The improvement of water quality in the downstream portions of Marion Creek is expected to increase the abundance and diversity of aquatic invertebrates, which are important for species such as Little Brown Myotis (*Myotis lucifugus*), Western Painted Turtle, and a variety of waterfowl.
- Success will be measured based on the size (in ha) of associated upland habitat that is improved along with the wetland construction. Sensors to measure dissolved oxygen and temperature in Marion Creek have already been installed up and downstream of the project site to collect baseline information to help with measuring changes that result from wetland construction.

Objective 3: Enhance land management partnerships and increase opportunities for research in the Columbia Valley.

- NCC and contractors will ensure all land management partners are briefed and updated on restoration activities as the project progresses. NCC will work with neighbors and relevant provincial biologists to ensure wetland construction meets shared landscape management objectives. In particular, the NTBC and staff from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) will be updated about activities taking place that are part of the shared vision for the enhancement of the larger Marion Creek watershed.
- Columbia Lake Ranch continue to use the aquatic resources provided by Marion Creek downstream of the project site, and they hold an active grazing licence on Thunder Hill Ranch. NCC staff have communicated the project to Columbia Lake Ranch and have received support for the project.
- The Columbia Headwaters Aquatic Restoration Secwépemc Strategy (CHARS) is a multi-year project led by researchers with the Shuswap Band with the goal to assess habitat and fish status in several tributaries throughout the Columbia Valley to determine restoration needs. A research permit has been granted by NCC for CHARS to study the portion of Marion Creek that crosses Thunder Hill Ranch, and researchers have been evaluating riparian habitat as well as conducting fish presence/absence surveys (including WCT), hydrologic modelling, and water quality analyses throughout 2020 and 2021. These assessments will contribute to the development of the Marion Creek Wetland Restoration Project design and will inform effectiveness monitoring efforts after construction is complete.

This project has begun to address the issues described within the *statement of need* by undertaking steps to complete Phase 1 of the Marion Creek Watershed Ecosystem Restoration Plan (Biebighauser 2018). Works completed by NCC under this grant will be referred to as “Phase 1a” from hereon out.

Due to considerable expansion of the project since the outset to place a stronger focus on WCT habitat improvement, Objective 1 has shifted. Plans are still evolving for the exact wetland design within the project area, but there will likely be more than 6 wetland pools. The focus will be to create a series of tiered wetland pools connected by a constructed stream channel to create habitat connectivity and diversity for WCT and benefit other aquatic and terrestrial species. The current concept map (Figure 1) shows approximately 4.2ha of wetland habitat restored, plus associated riparian and upland habitat. As this concept is still in the development stage, final restored areas will vary. The remaining goals and objectives are still in place and on track with the current project trajectory.

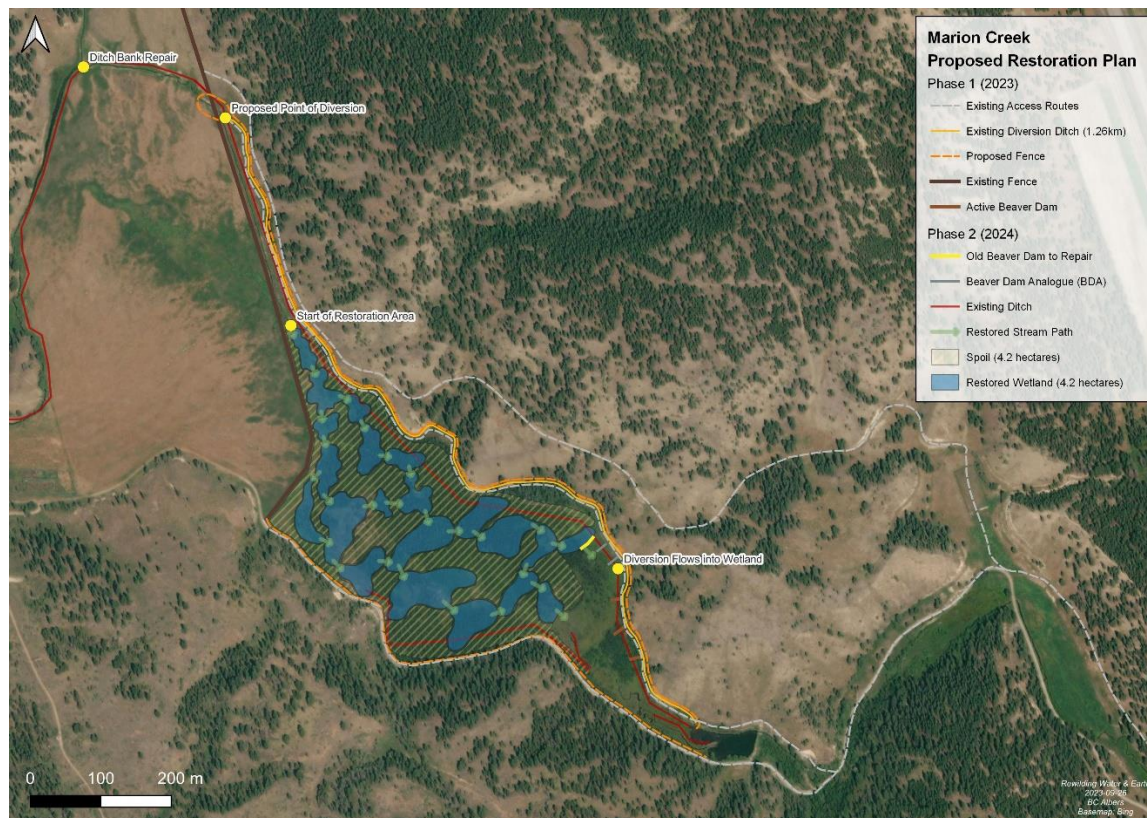


Figure 1. Concept map for the Marion Creek Restoration Project on NCC's Thunder Hill Ranch Conservation Area (RWE, 2023).

This project aligns with the FWCP's "Columbia Region Wetlands & Riparian Areas Action Plan" (FWCP 2021) and addresses Action 13: Restore and create wetland/riparian habitat-P1 and Action 36: Restoration of fish rearing and spawning habitat-P2. This project also aligns with the FWCP's "Columbia Region Uplands & Dryland Action Plan" (FWCP 2019) and addresses Action 12: Restoration of upland habitats-P1.

Wetland and riparian habitat along Marion Creek has been lost and degraded over the past 80 years due to extensive alterations made in an effort to divert water for downstream livestock use. Key sections of the creek on Thunder Hill Ranch Conservation Area have become channelized and cut off from the floodplain, causing the groundwater table to lower and wetlands and riparian areas to dry out (NCC 2021). This project aims to reverse these impacts by constructing wetlands on the landscape where they existed historically, and reconnect them to Marion Creek. This will raise the groundwater table and retain water on the landscape. Improvements in hydrologic function of the Marion Creek floodplain will help to restore native vegetation assemblages that feature sedges and aquatic plants and improve habitat for wildlife (NCC 2021).

The project will be completed based on the Marion Creek Watershed Ecosystem Restoration Project plan developed by a wetland specialist in 2018 (Biebighauser 2018), which outlines a two-phased approach for restoring hydrologic function to Marion Creek on Thunder Hill Ranch. This proposed project addresses Phase 1a of the plan. Under the guidance of a wetland specialist, heavy machinery was used to construct wetland and upland habitat. Researchers with the Shuswap Band are concurrently

completing riparian habitat and fish presence assessments for the Thunder Hill Ranch portion of Marion Creek through the CHARS, and NCC will continue collaborating with the CHARS project to inform best practices for restoration and monitoring.

This project will result in the restoration of over 8ha of upland habitat in an area that supports critical ungulate winter range. The property is known to support a variety of wildlife and species at risk, and species that are expected to benefit include Mule Deer (*Odocoileus hemionus*), Elk (*Cervus canadensis*), American Badger, and Common Nighthawk.

Study Area

The Project is taking place within the FWCP Columbia Region, East Kootenay subregion, of BC (Figure 2). The Thunder Hill Ranch conservation area is owned and managed by NCC and is located in the Upper Columbia Valley between Fairmont Hot Springs and Canal Flats . The property encompasses 423 ha of grassland and dry open forest, closed forest, and hydriparian ecosystems within the imperiled Interior Douglas-fir (IDF) biogeoclimatic zone. Its situation within a known wildlife corridor makes the property important for wide-ranging carnivores such as Gray Wolf (*Canis lupus*), Cougar (*Puma concolor*), and Grizzly Bear (*Ursus arctos*). In addition, the property contains critical habitat for Lewis's Woodpecker (*Melanerpes lewis*), ungulate winter range for Mule Deer, and important habitat for WCT in Marion Creek. Figure 3 shows the Phase 1a project area on the Thunder Hill Ranch Conservation Area. This project takes place the Traditional territory of the Ktunaxa and the Secwépemc (Shuswap Band).

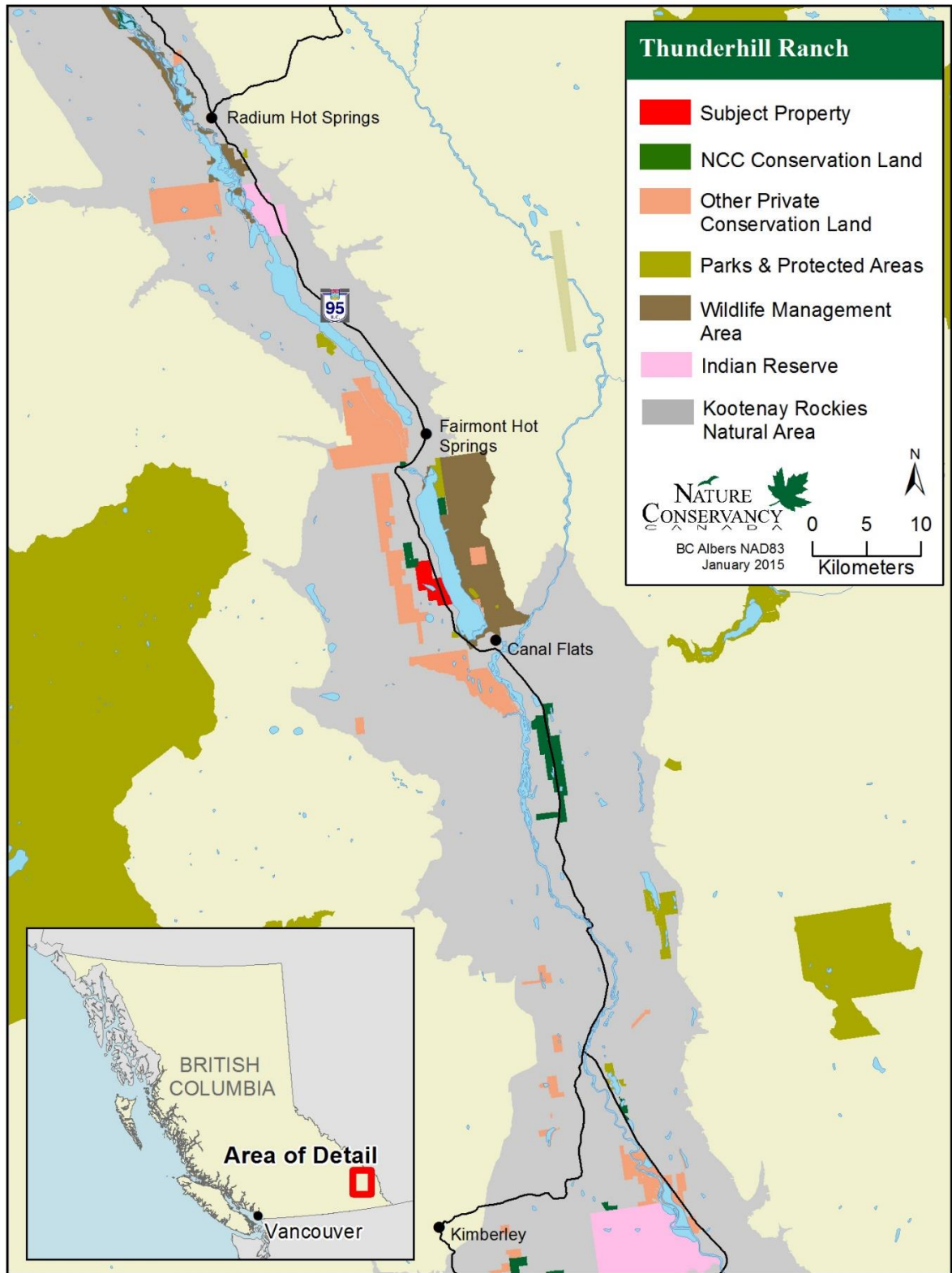


Figure 2. Context map showing the broader region of Thunder Hill Ranch Conservation Area, where the Project is occurring.

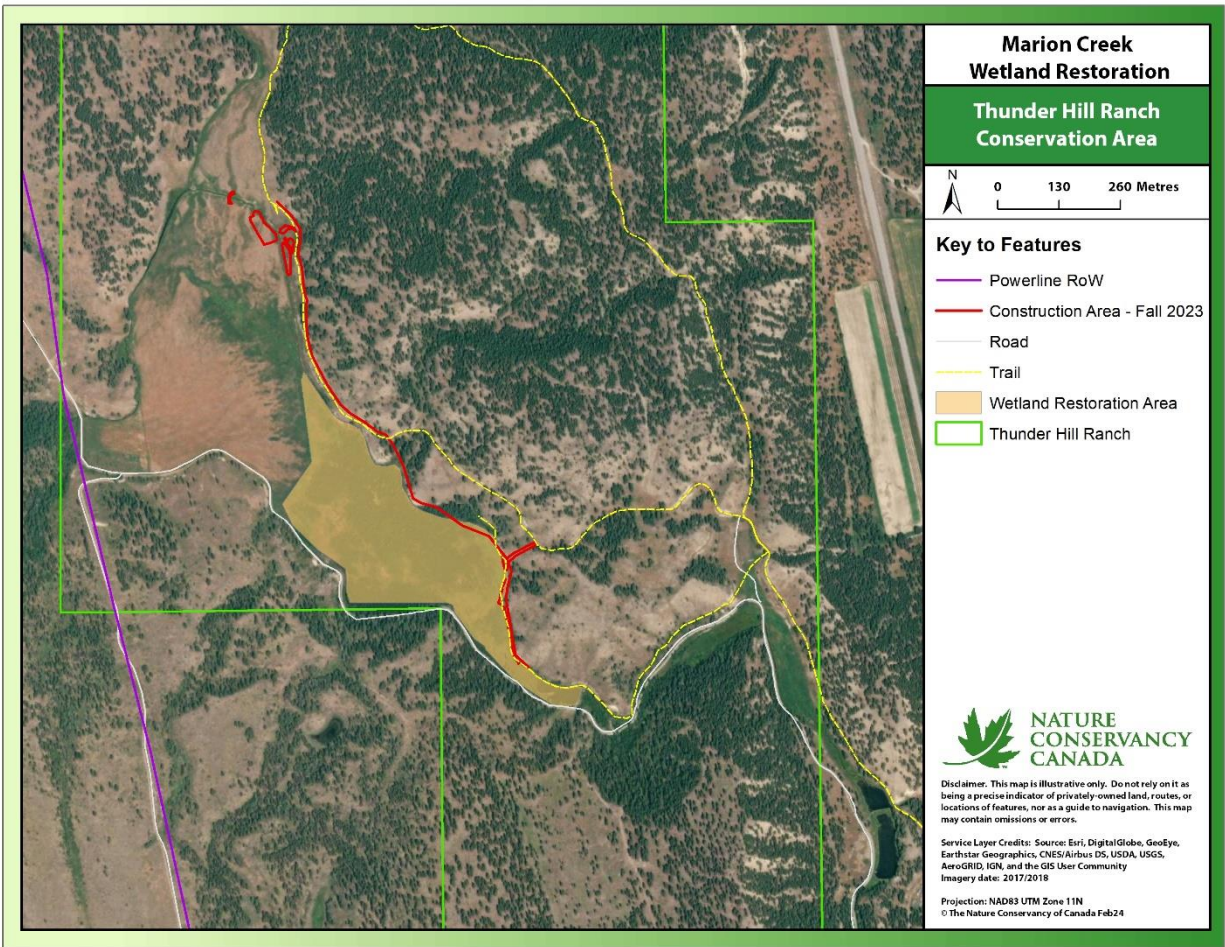


Figure 3. Site map showing the planned restoration area for Phase 1a of the Project.

Methods

NCC staff have worked closely with contracted wetland restoration specialists, Rewilding Water and Earth (RWE), from planning to construction stages of the project, and continue to work closely as we plan next steps. Tom Biebighauser developed the restoration design plan for Marion Creek in 2018. Tom has reduced his contracts and work in BC and is not available for the next phases of the project. The RWE team has trained extensively with Tom, learning the techniques he has developed for restoring wetlands. RWE has in depth knowledge and experience of Tom's techniques, as well as local and historical knowledge on the site, having worked on other wetland restoration projects in the region.

NCC has also worked closely with CHARS since the project outset. Jon Bissett, the fisheries biologist representing CHARS, has extensive experience working within the Marion Creek watershed, and has in depth knowledge of the WCT population. CHARS and their team have provided their expertise in the planning and implementation phases of the project.

NCC has also invited the Ktunaxa Nation Council, ʔakisq̓nuk First Nation, and Shuswap Band to participate in this project to the extent and capacity desired. Discussions are ongoing to support engagement throughout each stage of the project, including opportunities for future fieldwork.

RWE staff travelled to the site on July 4-5, 2023, for a site reconnaissance visit. RWE and NCC staff members worked with Columbia Lake Ranch to conduct soil test pit sampling and elevation surveying throughout the site. Using a small excavator, three test pits were dug throughout the proposed construction area to determine water table depth and soil horizon composition. RWE staff recorded the data to reference for further construction design and planning purposes. Excavated soil was immediately returned to the test pits. The site was also surveyed extensively by RWE staff using a surveyor's level to determine the elevation change throughout the site. This was used to help map the stream channel path and proposed wetland pool locations.

During the week of September 18-22, 2023, RWE was on site as preparatory construction work commenced. NCC hired a heavy equipment contractor, CF Xcavating, to complete the works under the supervision of RWE and NCC staff. A Cat 321 excavator was used to remove vegetation and repair a temporary diversion ditch. CHARS Fisheries Biologist and other staff were also on site for a number of days to provide advice and oversight.

On September 19, 2023, a Fisheries and Oceans Canada (DFO) representative conducted a site visit, accompanied by NCC, RWE, and CHARS staff. The purpose of the site visit was to provide site specific details on the construction plans, outlining the urgent need for restoration this section of Marion Creek, and describing the mitigation efforts all parties would take to ensure there would be no harm to WCT. This site visit was used to inform both DFO and the Province of British Columbia in issuing permit requirements to carry out the works.

RWE and CF Xcavating staff returned to the site for the week of October 10-13, 2023, for continued site preparation and construction activities. A Cat 321 excavator and Cat 305 mini excavator were used to complete these works. A dump truck was required to transport rock and material to the site.

During and after the fall construction period, fall rye, annual ryegrass, and/or a specialized upland native seed blend were spread over all areas of disturbed soil within the "construction area" (Figure 3). In areas identified as having increased erosion concerns, straw mulch was also spread to reduce erosion risk. A temporary electric fence was installed before cattle were moved into the grazing area to exclude cattle from the newly constructed berm.

Following the fall work, NCC, RWE, and CHARS have been in regular contact, participating in ongoing planning to ensure project activities will continue to meet objectives, while also considering long-term restoration plans to the area. Plans are in place for fall 2024 for continued construction on the site.

Results and Outcomes

The Project has continued to expand since the original funding application to FWCP was submitted. As such, the Project has been further broken into further phases. In 2023/24, we have accomplished Phase 1a. All preparatory work in anticipation for the stream diversion has been completed, along with significant design planning. Permitting, planning, and additional repair work are planned for 2024. Wetland pool and stream channel construction is now planned for summer/fall 2025.

During the planning stages, it was determined that the current flows from Marion Creek would need to be diverted around the construction site. An existing ditch, which was once used to divert the flow of Marion Creek around the agricultural field for irrigation purposes, was identified for the task.

During the September 18-22 construction period, heavy equipment was used to clear vegetation, creating access to the site. Over the course of five days, the perched diversion ditch was repaired by filling abandoned ground squirrel burrows and vegetation cleared from the ditch as necessary. Some stream channel construction was completed at this time. Slopes were calculated and modified as required.

From October 10-13, a Cat 321 excavator was used to build an outflow ditch, and to build berm at the diversion to ensure stream remains contained when diversion occurs. The Cat 321 was also used to unload and place rock and supersacks. The Cat 305 Mini Excavator was used to repair holes in the diversion ditch, carry woody debris to place in ditch, build and shape berms, and improve stream grade for fish. A dump truck was used to provide and transport gabion and radon rock material to the site, as well as to fill and transport supersacks to be used during the diversion. Pumps were run to test the rate at which the existing channel would de-water and the new channel would fill. This data will support planning and further preparations for the diversion. Materials were stockpiled on site for the next phases of construction. 1.25km of temporary diversion ditch has been repaired, and is now ready for the following phases.

NCC worked closely with DFO and the Province of British Columbia to ensure all appropriate permitting was in place before starting any in-stream works. NCC obtained a Section 11(1) and 11(2)– Changes In and About a Stream Approval under the *Water Sustainability Act* in October 2023. DFO issued a Letter of Advice in October 2023, and NCC continues to work to obtain any appropriate permits required under the *Fisheries Act*.

Once completed, this project will return the stream to its historic channel, connected by a series of wetland pools mimicking the beaver-created wetland pools that would have been historically present in the area. Re-naturalizing the landscape will have many benefits, including improving upland soil moisture content, reduced erosion within the stream channel, and improved habitat for the important population of WCT found in this stream. This will also address concerns identified through a hydrological assessment of the site (MacHydro 2022), which indicate that climate change will continue to worsen drought conditions in the watershed, therefore lowering water availability for ranchers and other users. This project will help retain water in wetland pools, filtering the water as it slowly leaves the basins, improving water availability later into the summer.

Although not yet fully constructed the proposed project is on track to create approximately 4.2ha of wetland pools, with 8.3ha of uplands directly impacted by the project, although exact numbers will differ based on the ongoing concept planning and conditions on the ground. The project will re-naturalize the agricultural landscape, providing habitat diversity for aquatic and terrestrial species, and improve resiliency in the face of a changing climate. It is also expected to reduce erosion and improve water filtration.

Discussion

The Project has expanded considerably since the outset and is now being broken further into phases to ensure the comprehensive stepwise completion of landscape-level restoration across the Thunder Hill Ranch Conservation Area. As the Project has grown to have a stronger focus on both wetland *and*

stream restoration centred around improving habitat for WCT, additional considerations have had to be made to mitigate any potential risks to fish and fish habitat throughout the project.

Phase 1a included the initial planning and diversion ditch preparation and testing, ahead of the stream diversion and wetland construction. NCC is still working with project contractors to define the next phases, which will be based on permit approvals and timing, conversations with DFO and fisheries biologists, weather and potential water restrictions, and timing activities around sensitive windows for fish, bird, and other wildlife species.

The larger goal of this project is to restore several sections of stream, connected by a series of wetland pools. Landscape-level planning is taking place to ensure each phase of the project will support the restoration of other sections of stream in the future. The Upper Columbia Valley will benefit from this project by improving the quality and supply of water in tributaries of Columbia Lake, as well as providing habitat for a diversity of wildlife including species at risk. Improving water retention on the landscape and returning Marion Creek to a natural, functional state will also make these ecosystems more resilient to the effects of climate change.

As part of the landscape-level planning, NCC will continue to work with Columbia Lake Ranch, who holds a grazing licence on the property. One of the project goals is to allow for ecologically aligned grazing to continue on the restored landscape. NCC has been working closely with Columbia Lake Ranch throughout the project and will ensure the project continues to allow for conservation-compatible cattle grazing on the property. NCC will be working with the ranch to install riparian fencing around the project to exclude livestock from the restored sites.

NCC experienced some challenges in implementing this project. With the considerable expansion of scope and objectives from the original proposal, additional considerations were required. Working in a fish bearing stream, especially one containing a SARA-listed species, required extensive permitting. While some permitting was anticipated, the timelines for permit approvals was greater than expected. Furthermore, it was determined by DFO that an additional permit was required as the project activities had the potential to cause harmful alteration, disruption or destruction (HADD) of fish habitat. This did delay progress of the project considerably. Although the Section 11(1) and 11(2)– Changes In and About a Stream Approval under the *Water Sustainability Act* and DFO a Letter of Advice were obtained in time to move ahead with water diversion, all project partners agreed it was best to take a step back and not take any unnecessary risk to moving fish at that time.

Regardless, NCC overcame these challenges by completing as much preparatory work as possible during the fall of 2023. NCC also considers it a success to be continuing with a cautious approach, ensuring that project is not rushed for the sake of progress. Taking the time to prepare and plan for the next steps, while continuing the permitting process, will ensure we are fully prepared with wetland design and fish harm mitigation strategies when we embark on future phases.

This project is supported by DFO, the Province of British Columbia, Columbia Lake Ranch, and local First Nations and Communities. Despite phases taking longer than anticipated, the Project has been highly collaborative and highly successful to date. With this large and complex project having the potential to positively impact countless species and landscape-level resiliency, it is imperative all parties take a cautious approach and ensure all aspects of the project are implemented thoughtfully.

Recommendations

To continue the success of the Project, a number of actions are recommended. Firstly, NCC will continue to work with RWE, CHARS and Columbia Lake Ranch to plan for the upcoming phases proposed for fall 2024, and for long term restoration planning of the site. NCC will also continue to work with DFO and the Province for all fisheries and environmental permitting, and to ensure any identified concerns are avoided or mitigated.

NCC is also working to obtain an archeological assessment for proposed future construction areas. While an Archeological Overview Assessment was completed for Thunder Hill Ranch Conservation Area (Choquette, 2009), a more detailed archeological assessment will be undertaken to ensure potential significant sites are not disturbed in the construction process.

It is also recommended to not only ensure continued engagement with local First Nation communities, but to provide tangible opportunities where community participation is welcome and encouraged. For example, NCC will ensure community members are included in upcoming fieldwork opportunities, which will include assisting with archeological assessments of proposed restoration sites, as well as monitoring and/or fish salvage opportunities during the stream diversion and construction activities.

NCC is grateful for FWCP's contributions to the Project thus far. NCC will continue to seek additional funding opportunities for the Project, including an application to FWCP in the upcoming grant intake cycle.

Acknowledgements

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NCC gratefully acknowledges the financial support of FWCP for its contribution to the Marion Creek Wetland Restoration Project. NCC also extends its gratitude to other funders and partners on the project, including the Columbia Basin Trust, Environment and Climate Change Canada, Regional District of East Kootenay – Columbia Valley Local Conservation Fund, Columbia Headwaters Aquatic Restoration Secwépemc Strategy, and Columbia Lake Ranch.

References

- Biebighauser, T. 2018. Marion Creek Watershed Ecosystem Restoration Project. Prepared for the Nature Conservancy of Canada. 98pp.
- Choquette, W.T. 2009. Archaeological Overview Assessment and Stewardship Plan for the NCC Thunder Hill Ranch Property. Prepared for the Nature Conservancy of Canada (34 pp).
- Fish and Wildlife Compensation Program (FWCP). 2021. Columbia Region: Wetlands & Riparian Areas Action Plan. Accessed from: <https://fwcp.ca/app/uploads/2021/01/Action-Plan-Columbia-Region-Wetlands-Riparian-Areas-Aug-12-2021.pdf> (March 8, 2024).

Fish and Wildlife Compensation Program (FWCP). 2019. Columbia Region: Upland & Dryland Action Plan. Accessed from: <https://fwcp.ca/app/uploads/2019/08/Action-Plan-Columbia-Region-Upland-Dryland-Aug-21-2019.pdf> (March 8, 2024).

MacDonald, R.J., Chernos, M.C. 2022. Hydrological assessment of Marion Creek, British Columbia. MacDonald Hydrology Consultants Ltd. Prepared for the Nature Conservancy of Canada. 16pp.

Nature Conservancy of Canada (NCC). 2021. Nature Conservancy of Canada – Marion Creek Wetland Restoration Project for FWCP 2022-23. Prepared for the Fish and Wildlife Compensation Program. 6pp.

Rewilding Water and Earth (RWE). 2023. Marion Creek Restoration Project Concept Map. Prepared for the Nature Conservancy of Canada. 1pp.

Rewilding Water and Earth (RWE). 2024. Marion Creek – Restoration Concept. Prepared for the Nature Conservancy of Canada. 1pp.

Appendix 1. Outline of the planned project phases and expected outcomes for each phase

Timeline	Project Phase	Outcomes
2018	Initiation	Tom Biebighauser developed a restoration plan for the Marion Creek project area.
Fall 2021-Fall 2022	Pre-work	An open span culvert downstream of the Marion Creek Wetland Restoration project area was replaced to improve fish passage. Associated riparian fencing was installed as part of this improvement, up to the intake related to the Columbia Lake Ranch water licence.
Fall 2023	1a	An existing ditch was identified to be used as a diversion ditch to carry water around the project site so that construction work can be done on dry land. In phase 1a, access was created to the diversion ditch. The ditch was repaired and graded as necessary to create habitat suitable for the temporary use by WCT. A berm was built at the point of diversion to ensure that the banks in this area can accommodate peak flows.
Winter 2023-Fall 2024	1b	<p>Phase 1b involves extensive data collection, planning, reporting, and permitting. A Construction Environmental Management Plan, construction report, and comprehensive fish salvage plan were created to support the following phases.</p> <p>Flow meters and hydrometric monitoring stations were installed to collect additional baseline data on Marion Creek to help inform next steps. An archeological Preliminary Field Reconnaissance (PFR) is being conducted to determine if any areas of archeological significance are present anywhere in the larger project area, including areas identified for longer-term restoration goals.</p> <p>The project team is also actively working on amending the Section 11 permit obtained under the provincial <i>Water Sustainability Act</i>, as well as obtaining any required permits under the <i>Fisheries Act</i>.</p> <p>In Fall 2024, the project team will conduct test pumping trials to determine if there will be any additional repairs needed to the diversion ditch. Depending on findings from the test pumping and PFR, repairs may be made to the diversion ditch as part of phase 1b, or phase 2.</p> <p>A bank breach identified in the existing irrigation channel not encompassed within the current project area is also to be repaired to reduce the risk of a bank blowout and fish strandings. A small amount of fencing may be required to exclude cattle from this restored section and ensure the integrity of the bank. A pond leveller may also be installed if deemed necessary.</p>
Fall 2024-Winter 2025	Phase 2a	Diversion, fish salvage, and ongoing monitoring.

		<p>The diversion of Marion Creek into the temporary diversion channel will occur in Phase 2a. With the fish salvage plan developed in phase 1b as a template, the project team will complete a fish salvage and divert Marion Creek into the diversion ditch.</p> <p>This phase will involve rigorous monitoring during and after the diversion to ensure flow levels are maintained. Monitoring will occur regularly for the duration of the time Marion Creek is diverted.</p> <p>The timeline for this phase may vary. It is tentatively scheduled for Fall 2024-Winter 2025, but may not occur until spring 2025 or later.</p>
Summer-Fall 2025	Phase 2b	<p>Construction of wetland pools and stream channel in Area 1 (Appendix 2), and reversion of Marion Creek through the project area.</p> <p>After the diversion and subsequent drying of the project area, heavy equipment will be used to clear vegetation and excavate pools and stream channels. Mitigation efforts identified as part of the CEMP will be implemented.</p> <p>Once the construction is complete, Marion Creek will slowly be re-diverted into the project area, again following specifications in the fish salvage plan and CEMP.</p> <p>Details are still being finalized as data collection and knowledge synthesis as part of phase 1b continues, and will also be informed by information collected in phase 2a.</p> <p>Following construction, exposed soils will immediately be seeded to reduce erosion. Riparian vegetation will be seeded and planted to promote re-vegetation with native plants suitable for the newly restored habitat. Livestock exclusion fencing will be installed around perimeter of the project. Effectiveness monitoring will be on-going.</p>
2026	Phase 3a	<p>Restoration of stream channel through Area 4 and/or Area 5 (Appendix 2) concurrently. This work will occur on dry land, without impacts to aquatic habitat.</p> <p>With support from Columbia Lake Ranch, it may be feasible to restore both Areas 4 and 5 concurrently. If not feasible, Area 4 will be prioritized, followed by Area 5.</p> <p>This phase will require the use of heavy equipment to construct stream channels with appropriate grades for WCT, connecting wetlands with a diversity of sizes, shapes, and depths. The new channel will be constructed as close to the historic stream channel</p>

		<p>as feasible. Gravel cattle crossings may be placed at strategic locations, allowing for grazing to still occur around the restored habitat. The riparian zone will be fenced to exclude cattle from the constructed wetlands and streams.</p>
2027	Phase 3b	<p>Reconnection of Areas 4, 5, and 1 through the diversion of Marion Creek.</p> <p>If restoration of Areas 4 and 5 (Appendix 2) cannot occur concurrently, Area 5 will first be restored in dry conditions during this phase, to avoid any impacts to fish habitat.</p> <p>Following the creation of the stream channel and associated wetland pools in Areas 4 and 5, Marion Creek will be diverted into this restored area. As with the previous stages, all necessary permits will be obtained. A comprehensive fish salvage plan will be followed, and qualified professionals will be on site.</p>
2028	Phase 4	<p>Restoration of West Branch Marion Creek through Area 3 (Appendix 2), and reconnection to Main Branch Marion Creek in Area 1.</p> <p>This phase will require the use of heavy equipment to construct stream channels with appropriate grades for WCT, connecting wetlands with a diversity of sizes, shapes, and depths. Gravel cattle crossings may be placed throughout, allowing for grazing to still occur around the restored habitat. The riparian zone will be fenced to exclude cattle from the constructed wetlands and streams.</p> <p>Following the creation of a new stream channel, located as close to the historic channel as feasible, connecting a series of wetland pools, Marion Creek will be diverted into the restored area. As with the previous stages, all necessary permits will be obtained. A comprehensive fish salvage plan will be followed, and qualified professionals will be on site.</p>
2029	Phase 5	<p>Restoration of Marion Creek in Areas 6 (Appendix 2), and reconnection to Main Branch Marion Creek in Areas 5 and 7 (Appendix 2).</p> <p>This phase will require the use of heavy equipment to construct stream channels with appropriate grades for WCT, connecting wetlands with a diversity of sizes, shapes, and depths. Gravel cattle crossings may be placed throughout, allowing for grazing to still occur around the restored habitat. The riparian zone will be fenced to exclude cattle from the constructed wetlands and streams.</p> <p>Following the creation of a new stream channel, located as close to the historic channel as feasible, connecting a series of wetland pools, Marion Creek will be diverted into the restored area. As with the previous stages, all necessary permits will be obtained. A</p>

		comprehensive fish salvage plan will be followed, and qualified professionals will be on site. Effectiveness monitoring continues beyond 2029.
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Appendix 2. Map showing the restoration context of the entire project site being considered for long-term landscape-level restoration planning (Rewilding Water and Earth, 2024). **Note:** This is a concept map only. The wetlands depicted here are intended to show the general idea of the restoration, **not** real areas on the ground. Wetlands may not actually be constructed to size, scale, and number as shown in map.

